Community Report for Persistent, Bioaccumulative Chemicals

Fond du Lac Community Biomonitoring Study

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MINNESOTA MDH DEPARTMENT OF HEALTH

ATSDR
AGENCY FOR TOXIC SUBSTANCES AND DISEASE REGISTRY

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Most of all, we are indebted to the 491 volunteers who took part in the study so we may all better understand our relationship with the chemicals in the world around us.

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Background

About This Report

This report summarizes results for several **persistent**, **bioaccumulative chemicals** measured in the Fond du Lac (FDL) Community Biomonitoring Study. The intended audience of this report is the FDL Community, including people who took part in the study.

This report is the second community report from this project. The ***Community Report for Cadmium, Lead, and Mercury*** was released in July 2014 and is available on the FDL Human Services biomonitoring web page: http://www.fdlrez.com/HumanServices/biomonitoring.htm

For more information about the project, visit the web page above or call the Minnesota Department of Health at 651-201-4897 (toll free 1-800-657-3908) or send an email to health.hazard@state.mn.us.

Study Background

The Great Lakes are among the world's most important freshwater resources. The lakes and the surrounding lands provide natural beauty and are vital to the lives of millions of people. Unfortunately, a long history of careless practices contaminated the Great Lakes ecosystem and Lake Superior watershed with numerous chemicals and byproducts of modern life. Sources of chemical releases include industrial discharges, spills, contaminated runoff, waste disposal, and use of consumer products.

The Great Lakes Restoration Initiative (GLRI) was established under the stewardship of the U.S. Environmental Protection Agency (EPA) in 2009. The GLRI aims to protect, restore, and maintain the Great Lakes ecosystem. With GLRI support, the Agency for Toxic Substances and Disease Registry (ATSDR), within the Centers for Disease Control and Prevention, created a Great Lakes Biomonitoring Program. This program funds projects to gather baseline data on environmental chemicals in people who may have a higher risk of exposure to Great Lakes contaminants. In September 2010, ATSDR awarded funds to state health agencies in Minnesota, Michigan, and New York to conduct biomonitoring.

From January through November 1, 2013, the Fond du Lac Band of Lake Superior Chippewa, in partnership with the Minnesota Department of Health, collected blood and urine samples, and questionnaire data from 491 people who took part in the FDL Community Biomonitoring Study.

Biomonitoring is a tool used to understand exposures to environmental chemicals. It involves measuring the amount of specific chemicals in people's bodies (often in blood or urine).

Study Purpose

The purposes of the FDL Community Biomonitoring Study are to identify:

1. the amount of certain chemicals in participants' blood or urine;
2. whether any groups (such as women or elders) are exposed to greater amounts of study chemicals;
3. possible sources of exposure to the chemicals found in participants' blood; and
4. how the amounts found in participants compare to other populations.

> ***The Results Summary addresses these four purposes under the headings:***
>
> - *Amounts Measured*
> - *Groups with Greater Exposure*
> - *Possible Sources of Exposure*
> - *Comparison to Other Populations*

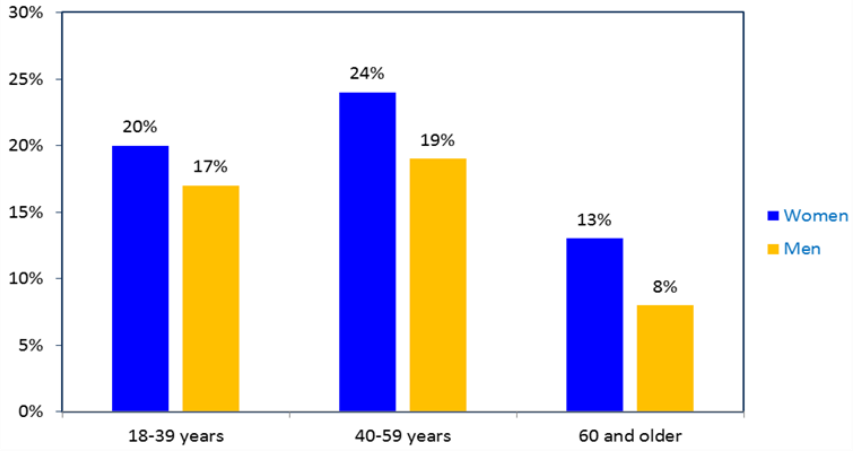
Study Participants

Participants (as a group) for this study are referred to as the "FDL Community". Study participants who met the eligibility requirements are members or affiliates of any federally recognized tribe, including members of the FDL Band of Lake Superior Chippewa.

Between January and November 2013, study staff invited 1,343 people (chosen randomly from the FDL Human Services "client list") to take part in the study. The goal was to contact each person individually to find out if they were eligible and willing to be in the study. To be eligible, a person had to be at least 18 years old and live in the FDL clinics' service area.

Study staff reached 829 people, of whom 60 were not eligible and 278 declined. The remaining 491 people gave blood and urine samples and completed a questionnaire. The participants came from Cloquet (52%), Duluth (31%), and 17 other communities and rural areas (17%). More women (57%) than men (43%) took part. Figure 1 shows the participants by age group and gender.

Figure 1. Age and Gender of Study Participants*



Out of the 491 participants, we tested 490 blood samples for persistent, bioaccumulative chemicals. One person's sample was damaged during shipping.

Chemicals in this Report

This report summarizes biomonitoring results for several chemicals: DDT and DDE, hexachlorobenzene (HCB), mirex, polychlorinated biphenyls (PCBs), and toxaphene. These chemicals are persistent and bioaccumulative.

- **Persistent** chemicals stay in the environment and in people's bodies for a long time – often decades.
- **Bioaccumulative** chemicals build up in the food chain. Predators higher on the food chain (fish, birds, and mammals) have greater amounts than plants and animals lower on the food chain. Bioaccumulative chemicals also build up in people's bodies over time.

Example of bioaccumulation: fish that feed on other fish have higher amounts of these chemicals than their prey. Photo source: MN DNR

These chemicals were used in many types of products but are no longer manufactured or sold in the U.S. They were banned (mostly in the 1970's or 1980's) and since then have been decreasing in the environment, in food, and in people. Small amounts from past use still remain in the environment, including the Lake Superior Basin.

Some of these chemicals are still used in other countries. For example, DDT is a pesticide currently used in some parts of the world to control diseases spread by mosquitos. Current use in other countries also contributes to amounts found in the Lake Superior Basin because these chemicals can travel long distances in air.

More information on each chemical is in Appendix 1 or visit the U.S. Centers for Disease Control and Prevention's ToxFAQs™ website: http://www.atsdr.cdc.gov/toxfaqs/index.asp.

Today, the main way people in the U.S. are exposed to the chemicals described in this report is by eating food; particularly fish, animal fats, and dairy products. These foods contain small amounts.

In many studies, including the on-going study of the U.S. population, declines in blood levels of these chemicals have been found over the past few decades[1]. Older people typically have more

[1] U.S. Centers for Disease Control and Prevention. Fourth National Report on Human Exposure to Environmental Chemicals. 2009. http://www.cdc.gov/exposurereport/pdf/fourthreport.pdf

of these chemicals in their bodies because they lived at a time when there were greater amounts in the environment. Also, a long life gives these chemicals more time to build up in the body.

Finding these chemicals in people's blood does not mean their health is affected or that they will get sick. It only means they were exposed to the chemicals. Laboratory animals can be affected when they are given high doses of these chemicals, but not enough is known about what amounts might affect people's health. Scientists are still studying whether the amounts found in people today cause harm.

Although we do not know what an individual participant's results mean for their health, the amounts measured in all participants as a whole are very meaningful. Study results tell us:

- "baseline" levels of these chemicals in participants that can be used to monitor changes over time
- whether certain groups of people within a population have greater exposure than others
- about possible chemical sources in participants, when combined with questionnaire information
- how the amounts of these chemicals in participants compare to other populations

Understanding the Biomonitoring Results

This section will help you understand the results that follow in the Results Summary (page 6) and Chemical-specific Results (Appendix 1, page 11).

St. Louis River.
Photo courtesy of Nancy Schuldt.

Chemical Amounts

These chemicals are measured in ***nanograms*** per gram of blood ***lipid***. A ***nanogram*** is a very tiny amount - one billionth of a gram. ***Lipids*** are fat-like components in people's blood.

Chemical Results

Three types of summary results are shown:

1. **Percent of people with a detectible level.** This is the number of participants with a measurable amount of the chemical in their blood, divided by the total number tested. It tells us how widespread exposure to the chemical is in people.
    - A person has a detectible level when the chemical amount found in blood is the same or greater than the detection limit. The detection limit is the lowest level a chemical can be measured accurately by the lab.
    - The detection limit is not the same for all chemicals in this report.
2. The **middle value**. The middle value is where half of people tested were below and half were above the value. It represents the middle of the results, similar to an average. The middle value is also known as a "median" or "50th percentile".
3. The **95 percent value**. Ninety-five percent of people tested had a result that was less than the 95 percent value. It is a standard way to show a value at the higher end of the range of results.

> ***A result above a middle value or 95 percent value does not signify a health concern.*** *Rather, the values help us understand whether the participants in this study look similar to other populations when comparing the middle and upper-end of the results.*

Results in Appendix 1 are shown for three age groups because **the chance of finding persistent, bioaccumulative chemicals increases with age**. All FDL summary results for the 20-39 year age group include a small number of 19-year olds.

Other Population's Results

For comparison, we show summary results from three other populations in Appendix 1:

- **U.S. General Population**. These are people across the U.S. tested by the Centers for Disease Control and Prevention from 2003-2004. For more information, go to www.cdc.gov/exposurereport.
- **First Nations Canada**. These are people in 13 First Nations communities across Canada who were tested by the Assembly of First Nations in 2011. For more information, go to www.afn.ca/uploads/files/afn_fnbi_en.pdf.
- **Canadian General Population**. These are people across Canada tested by Health Canada from 2007-2009. We used the Canadian results for toxaphene because the U.S study

> ***Important note*****:** *Summary results for the U.S. General Population are ten years older than FDL results.* ***We expect older results to be higher*** *because these chemicals are decreasing in the environment over time.*

does not test for it. For more information, go to http://www.hc-sc.gc.ca/ewh-semt/pubs/contaminants/chms-ecms/index-eng.php

Possible Sources of Exposure

We compared participants' responses from the questionnaire with their blood results to look for possible explanations for the amounts and the sources of chemicals measured in their blood. The questionnaire asked about activities (such as work, hobbies, recreation, and smoking), items people consume (certain food, dietary supplements), and use of personal care products. For the chemicals in this report, we chose to focus on traditional foods that participants ate in the last year, including wild rice, wild game, and fish. Food is the main source of exposure to these persistent, bioaccumulative chemicals.

You can read about the amounts and kinds of fish participants said they ate on page 8 of the ***Community Report for Cadmium, Lead, and Mercury*** available at: *http://www.fdlrez.com/HumanServices/biomonitoring.htm*

Results Summary for the FDL Community

This section is a summary of the detailed results, which are found in Appendix 1.

Amounts Measured

Table 1 summarizes the results. DDE was the most commonly found chemical in people (98%) followed by toxaphene 50 (82%). DDE had the highest middle and 95 percent values. Toxaphene 26 and 50 had the lowest values.

Table 1. Summary Results for the FDL Community*

Chemical**	Percent of people with a detectible level	Middle value (in nanograms per gram lipid)	95 percent value (in nanograms per gram lipid)
DDE	98%	86.4	531.5
HCB	34%	ND	16.9
PCB 153	56%	12.3	55.2
PCB 180	64%	10.2	41.0
Toxaphene 26	38%	ND	1.5
Toxaphene 50	82%	0.69	3.2

ND=Not detected in at least 50% of people, so a middle value cannot be calculated

* See page 4 to help you understand the information in the table.

**DDT and mirex are not included in the table because they were only found in 1-2% of people.

PCBs and toxaphene are actually *groups of chemicals* rather than a single chemical. Each individual chemical in the group has a unique number to distinguish it from the rest. In the table above, PCB 153 and 180 and toxaphene 26 and 50 are good indicators of overall exposure

to these chemical groups because they are commonly found in people. Other PCBs and toxaphenes were also found in participants, but less frequently. Those found in at least 10% of people are below:

Chemical	Percent of people with a detectible level
PCB 118	14%
PCB 138 + PCB 163	21%
PCB 156	12%
PCB 170	38%
PCB 187	27%
PCB 194	28%
PCB 199	24%
Toxaphene 40	10%
Toxaphene 41	15%

Groups with Greater Exposure

Age

Age had the biggest influence on the chemical amounts found in people's blood. This finding is consistent with other studies. For every chemical in this report, the amount measured in blood increased as age increased. Two reasons why persistent, bioaccumulative chemicals are higher in older people than younger people are: 1) older people lived at a time when there were greater amounts of these chemicals in the environment, and 2) these chemicals have had more time to accumulate in the body. Results by age group are in Appendix 1.

Gender

We did not find differences in the chemical amounts between men and women.

Possible Sources of Exposure

Because traditional foods are important to the community, we chose to focus on these questions from the questionnaire as possible sources of exposure.

Wild rice, wild game, wild berries, and medicinal plants

Participants who ate wild rice, wild game, and wild berries or used medicinal plants did not have higher levels of these chemicals in their blood. We found no relationship between these chemicals and eating wild rice, wild game, wild berries, or medicinal plants in the past year.

Fish

Because persistent, bioaccumulative chemicals are typically found in fish, people can be exposed to small amounts of them by eating fish. In general, participants who ate more fish did not have higher levels of these chemicals in their blood. As a group, participants who said they ate Lake Superior fish in the past year tended to have higher amounts of toxaphene in their blood compared to those who did not report eating any meals of Lake Superior fish. However, the overall amount of toxaphene found in all participants' blood was small.

Of the chemicals measured in this report, other studies show:

- PCBs and toxaphene are present in fish from Lake Superior.
- Fish from inland lakes and streams do not generally contain PCBs or toxaphene.
- The amount of toxaphene and PCBs in Lake Superior fish has gone down over time[2].

Limitations

When looking for exposure sources of these chemicals, our ability to relate questionnaire responses to blood results is limited.

- We do not know how much of a chemical currently in a participant's blood is from recent exposure versus past exposure. These results are a snapshot in time.
- The FDL Band cancelled the annual netting event at Lake Mille Lacs during the study period. Typically, many people participate in the event, and the fish harvest is shared widely in the community. Fish consumption, and therefore chemical amounts in blood, may be different during years when this netting event occurs.
- This study primarily focused on types and quantities of traditional foods that participants ate within the past year. People could have also been exposed to these chemicals in traditional foods eaten more than one year ago. There may be other sources of exposure to these chemicals not asked about in the study questionnaire.

Comparison to Other Populations

We compared results from the FDL Community Biomonitoring Study to results available from other studies. In general, the FDL Community appears similar to the other comparison populations (see Appendix 1).

[2] Xia X. et al. Toxaphene trends in the Great Lakes fish. *Journal of Great Lakes Research* 38 (2012) 31-38.

Conclusions

We expected to find these chemicals in participants' blood because they are still in the environment, they stay in the body for a long time, and other studies have found these chemicals in people's blood. This study showed:

- DDT and DDE, hexachlorobenzene (HCB), mirex, polychlorinated biphenyls (PCBs), and toxaphene were found in some participants' blood. These baseline data can be used to monitor changes over time.
- Younger participants had lower amounts of chemicals in blood compared to older participants. In general, the amount of chemicals in blood increased as age increased.
- We did not find differences in the chemical amounts between men and women.
- Continuing to eat wild rice, wild game, and wild berries or use medicinal plants are not expected to increase people's exposure to these chemicals.
- We expected participants who reported eating Lake Superior fish in the last year might have toxaphene in their blood. As a group, participants who reported eating Lake Superior fish in the past year tended to have higher amounts of toxaphene in their blood than those who did not eat any Lake Superior fish in the past year. However, the overall amount of toxaphene found in participants' blood was small. Because toxaphene stays in the body for a long time, toxaphene levels in blood today may be more reflective of past exposures.
- The chemical amounts found in participants are similar to those found in other recent studies and lower than studies done in the past. This is consistent with a decline in environmental levels over time, and suggests blood levels will be lower in future generations.

Recommendations

Based on the findings of this report for persistent, bioaccumulative chemicals, people in the FDL Community can:

- Eat wild rice, wild game, and wild berries as part of a traditional diet.
    - We did not find any relationship between the chemicals in this report and current eating of these traditional foods.
- Use medicinal plants.
    - We did not find any relationship between the chemicals in this report and using medicinal plants.
- Eat fish as part of a healthy diet.
    - Follow the **safe eating guidelines for fish** on the FDL biomonitoring webpage: http://www.fdlrez.com/HumanServices/biomonitoring.htm.

- Specific guidelines for eating Lake Superior fish are on the Minnesota Department of Health's website: http://www.health.state.mn.us/divs/eh/fish/eating/sitespecific.html.
  - The Lake Superior guidelines are based on levels of mercury and PCBs measured in fish. Lake Superior fish may also contain toxaphene. At the levels found in Lake Superior fish, toxaphene is less of a concern than mercury and PCBs. Following the guidelines will keep these chemicals from building up to harmful levels in your body.
  - Lake Superior fish with the lowest levels of contaminants include Lake Herring (cisco), Lake Whitefish, and Coho Salmon.
- These chemicals are mainly in the fat of fish. When preparing fatty fish, remove the skin, trim the fat, and broil, bake, or grill the fish so that the fat drips away.
- For further questions about eating fish safely, please contact Nancy Schuldt - FDL Natural Resources Division - at (218) 878-7110.

To lower exposure to these chemicals, people can also:

- Eat low fat dairy products and lean meats
  - These chemicals are found in fatty foods so choose low fat options to keep exposure low.

Appendix 1:

Chemical-specific Results for the FDL Community Biomonitoring Study

See page 4 to help you understand the information in Appendix 1.

DDT and DDE

Background

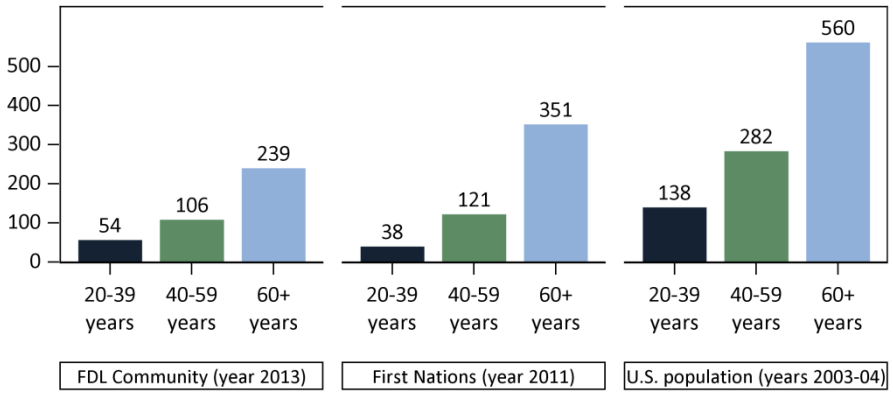
DDT is a pesticide that was widely used in the U.S. until 1972, when most of its uses were banned. DDT breaks down in the environment and inside people's bodies to DDE. DDE stays in the body longer than DDT. For these reasons, mainly DDE is found in people in the U.S. today.

Results by age group

- We found DDT in 2% of participants. Since there were so few people with DDT, we could not look at it in further depth.
- We found DDE in 98% of participants. It was found in all age groups (20-39 years old, 40-59 years old, and 60 years and older).
- Although we found DDE in nearly all participants, older people had greater amounts of DDE compared to younger people. The graphs below show that DDE increases with age.
- FDL *middle values* and *95 percent values* for DDE were lower compared to both U.S. and First Nations populations, except for the youngest age group. FDL participants in the 20-39 year age group had slightly higher values than First Nations participants of similar age.

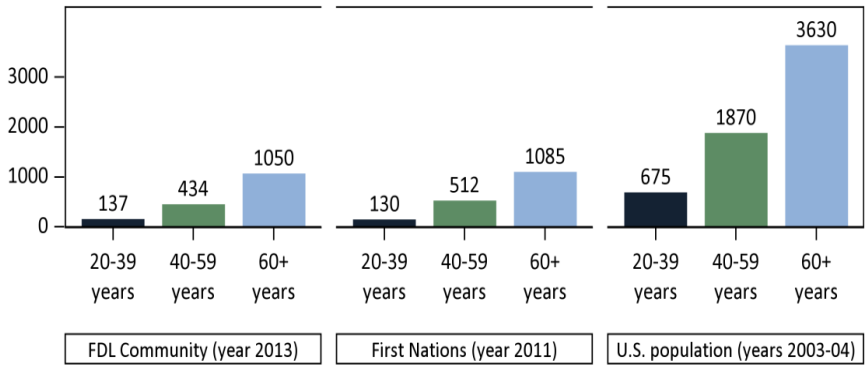
Middle Values for DDE

in nanograms of DDE per gram of lipid in blood



95 Percent Values for DDE

in nanograms of DDE per gram of lipid in blood



Hexachlorobenzene (HCB)

Background

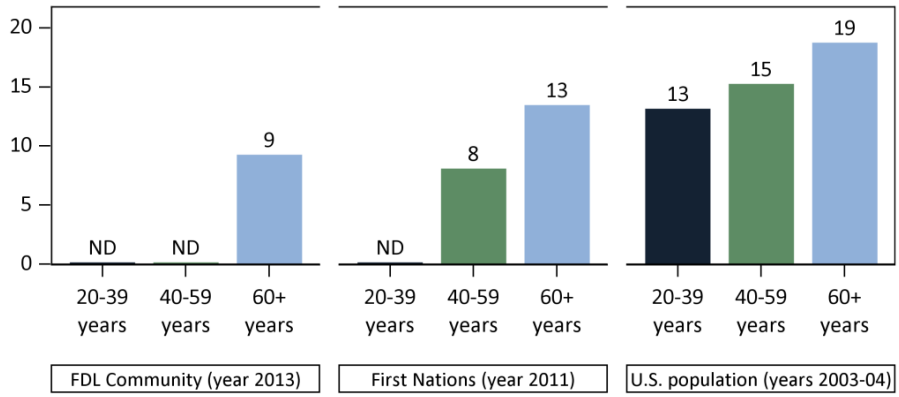
Hexachlorobenzene (HCB) was mainly used as a fungicide in the U.S. until it was banned in 1984. Although HCB is no longer used in any products, it is still formed as a byproduct during the manufacture of some chemicals and when garbage is burned. As a result, tiny amounts are still released into the environment.

Results by age group

- HCB was found in 34% of participants, including:
  - 15% of people ages 20-39
  - 41% of people ages 40-59
  - 54% of people ages 60 and older
- Older people had greater amounts of HCB compared to younger people (see graphs below).
- FDL *middle values* and *95 percent values* for HCB were lower or about the same compared to similar age groups in the U.S. and First Nations populations.

Middle Values for HCB

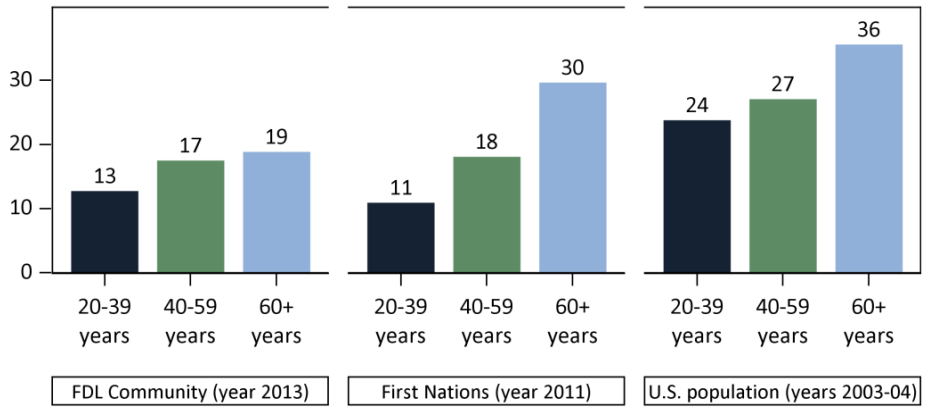
in nanograms of HCB per gram of lipid in blood



ND=Not detected in at least 50% of people in this age group, so a median cannot be calculated

95 Percent Values for HCB

in nanograms of HCB per gram of lipid in blood



PCB 153

Background

Polychlorinated biphenyls (PCBs) are a group of 209 related chemicals. Before their production in the U.S. was banned in 1979, they were widely used as coolants and lubricants in electrical equipment and as additives to paints, oils, joint caulking, and floor tiles. Today, exposure to PCBs for most people comes from eating food, including fish caught in contaminated lakes or rivers. In Minnesota, fish in Lake Superior and some major rivers, including the Saint Louis River, may contain PCBs. People whose jobs involve repairing and maintaining old electrical equipment may also be exposed to PCBs.

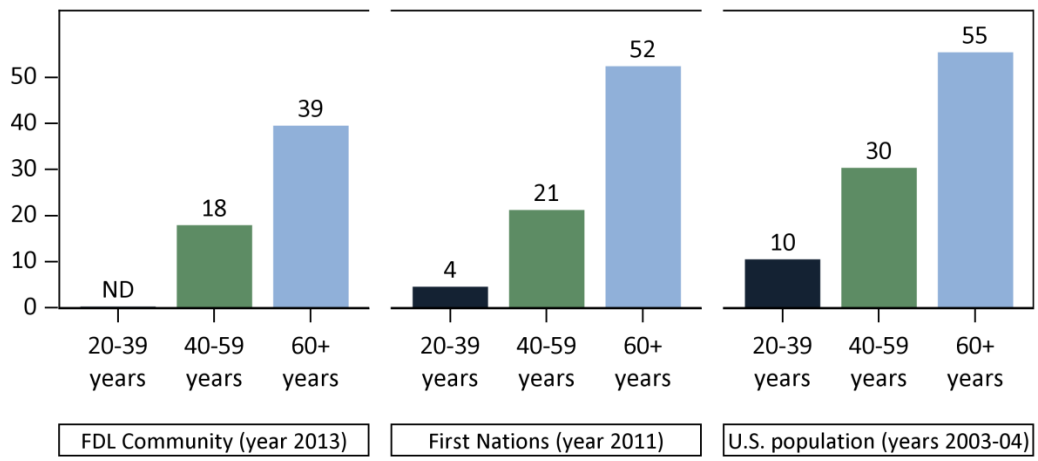
Each individual PCB chemical is assigned a unique number. This report includes results for PCB 153 and 180. These were the most commonly found PCBs in this study and other studies. We looked for other PCBs in this study, but we did not find them as frequently (see page 7).

Results by age group

- PCB 153 was found in 56% of participants, including:
  - 13% of people ages 20-39
  - 75% of people ages 40-59
  - 96% of people ages 60 and older
- Older people had greater amounts of PCB 153 compared to younger people (see graphs below).
- FDL *middle values* and *95 percent values* for PCB 153 were lower compared to U.S. and First Nations populations. 95 percent values were not reported for some First Nations age groups.

Middle Values for PCB 153

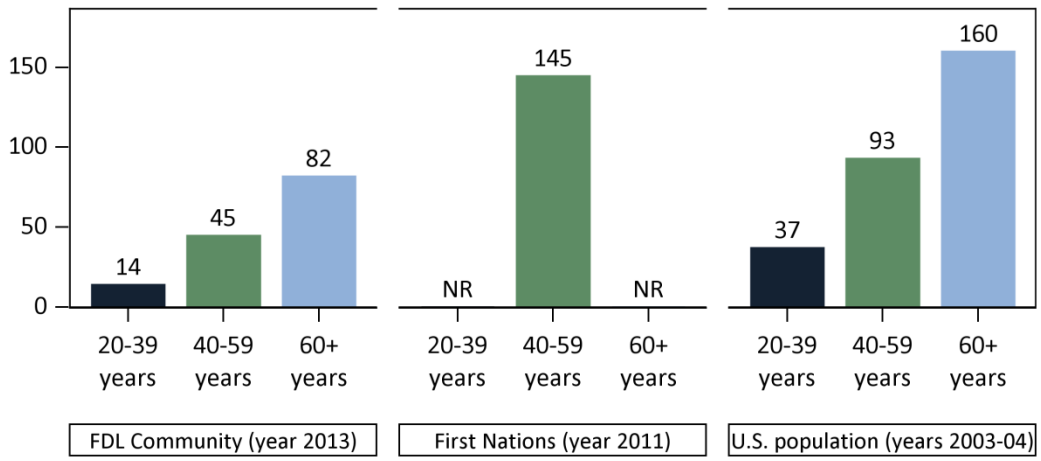
in nanograms of PCB per gram of lipid in blood



ND=Not detected in at least 50% of people in this age group, so a middle value cannot be calculated

95 Percent Values for PCB 153

in nanograms of PCB per gram of lipid in blood



NR=Not reported

PCB 180

Background

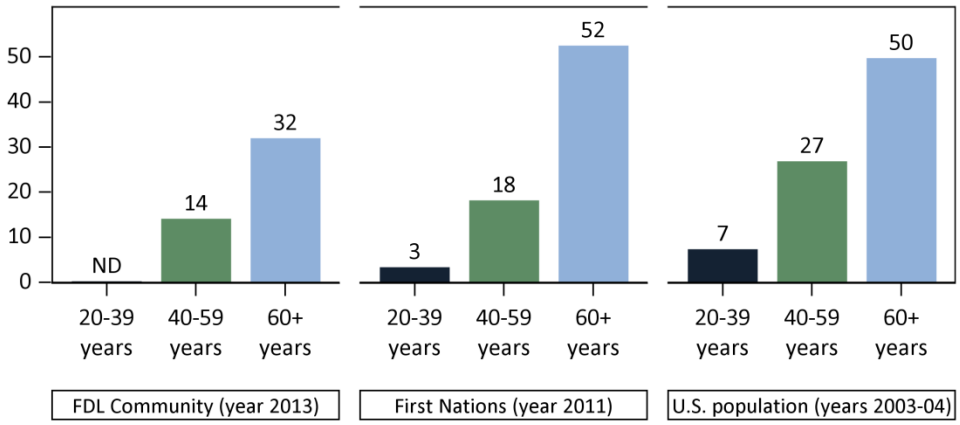
See page 14 for background information on PCBs.

Results by age group

- PCB 180 was found in 64% of participants, including:
  - 19% of people ages 20-39
  - 86% of people ages 40-59
  - 99% of people ages 60 and older
- Older people had greater amounts of PCB 180 compared to young people (see graphs below).
- FDL *middle values* and *95 percent values* for PCB 180 were lower compared to U.S. and First Nations populations. 95 percent values were not reported for some First Nations age groups.

Middle Values for PCB 180

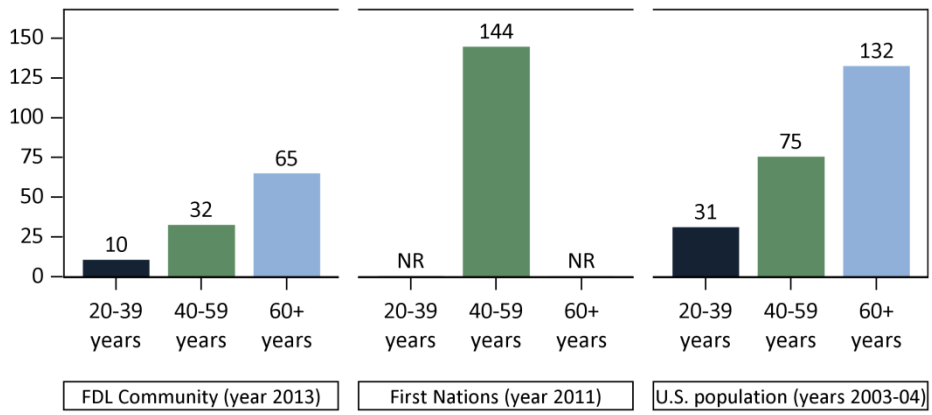
in nanograms of PCB per gram of lipid in blood



ND=Not detected in at least 50% of people in this age group, so a middle value cannot be calculated

95 Percent Values for PCB 180

in nanograms of PCB per gram of lipid in blood



NR=Not reported

Toxaphene 26

Background

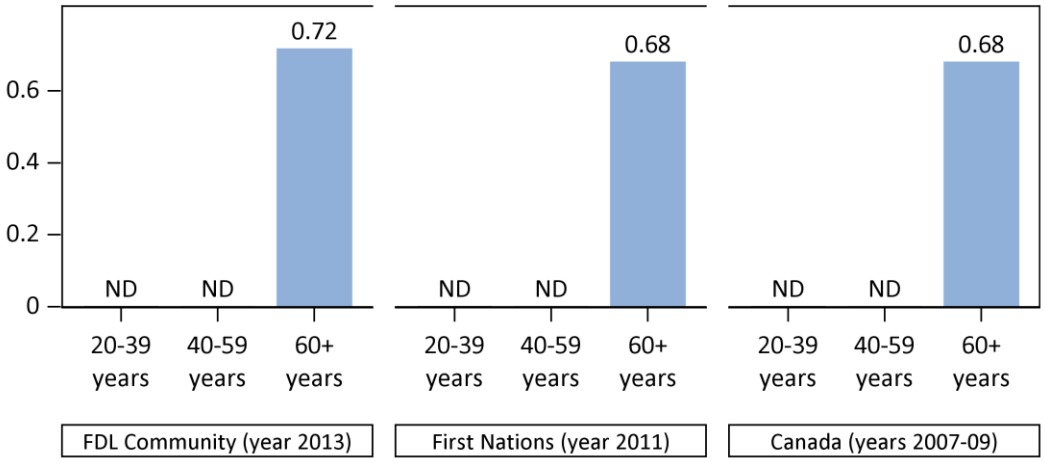
Toxaphene is not one chemical but a mixture of related chemicals. This mixture was used as a pesticide, mainly in the southern U.S., until it was banned in 1990. Toxaphene has been carried on wind currents from areas where it was commonly used to the waters of the Great Lakes. Once toxaphene falls into Lake Superior, the lake never gets warm enough to allow much toxaphene to go airborne again. As a result, Lake Superior has a higher level of toxaphene compared to the other Great Lakes. Toxaphene has not been found in Minnesota's inland lakes and rivers.

Results by age group

- Toxaphene 26 was found in 38% of participants, including:
  - 16% of people ages 20-39
  - 41% of people ages 40-59
  - 70% of people ages 60 and older
- Older people had greater amounts of toxaphene 26 compared to younger people (see graphs below).
- The graphs below show summary results by age group for the FDL Community, First Nations, and the general *Canadian* population (the U.S. study does not test for toxaphene). FDL *middle values* for toxaphene 26 were about the same as those in First Nations and Canadian populations. FDL *95 percent values* for participants' ages 20-39 years were higher than the First Nations study but lower than the Canadian general population.

Middle Values for Toxaphene 26

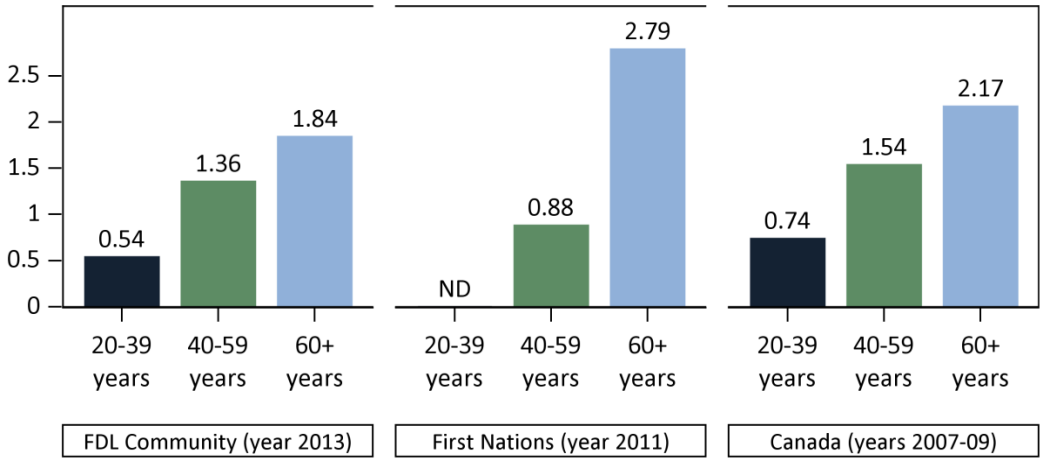
in nanograms of toxaphene per gram of lipid in blood



ND=Not detected in at least 50% of people in this age group, so a middle value cannot be calculated

95 Percent Values for Toxaphene 26

in nanograms of toxaphene per gram of lipid in blood



ND=Not detected in at least 95% of people in this age group, so a 95 percent value cannot be calculated

Toxaphene 50

Background

See page 17 for background information on toxaphene.

Results by age group

- Toxaphene 50 was found in 82% of participants, including:
  - 68% of people ages 20-39
  - 87% of people ages 40-59
  - 96% of people ages 60 and older

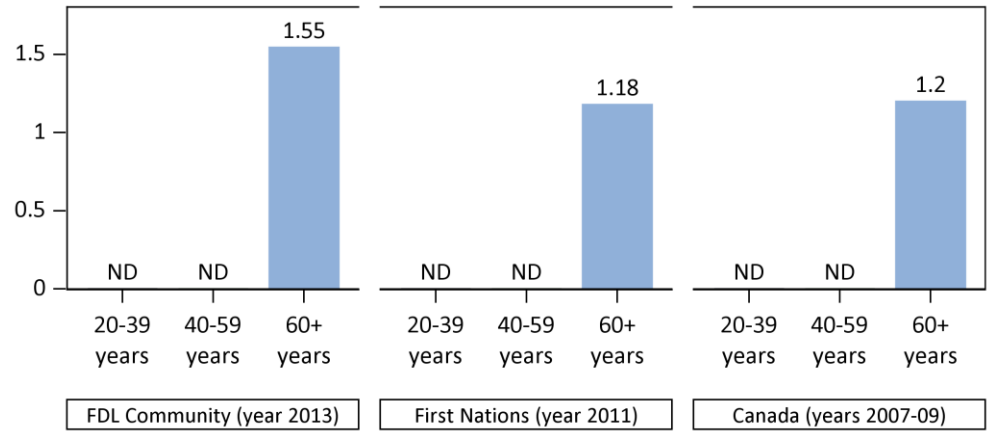
- Older people had greater amounts of toxaphene 50 compared to younger people (see graphs below).

- The graphs below show summary results by age group for the FDL Community, First Nations, and the gener*al Canadian* population (the U.S. study does not test for toxaphene). The lab for the FDL study was able to measure toxaphene at levels 10 times lower than what could be measured in the First Nations and Canadian populations. For this reason, FDL Community middle values in the graph for toxaphene 50 are based on the higher Canadian and First Nations detection limit to improve comparability[3]. The FDL middle value for the oldest age group was slightly higher compared to First Nations and Canadian groups of similar age. The 95 percent values were higher in the FDL Community compared to most First Nations and general Canadian age groups. However, differences between the population groups were very small.

[3] FDL results in the other toxaphene graphs are based on the lower FDL detection limit. The difference in detection limit between studies does not affect comparability in these other graphs.

Middle Values for Toxaphene 50

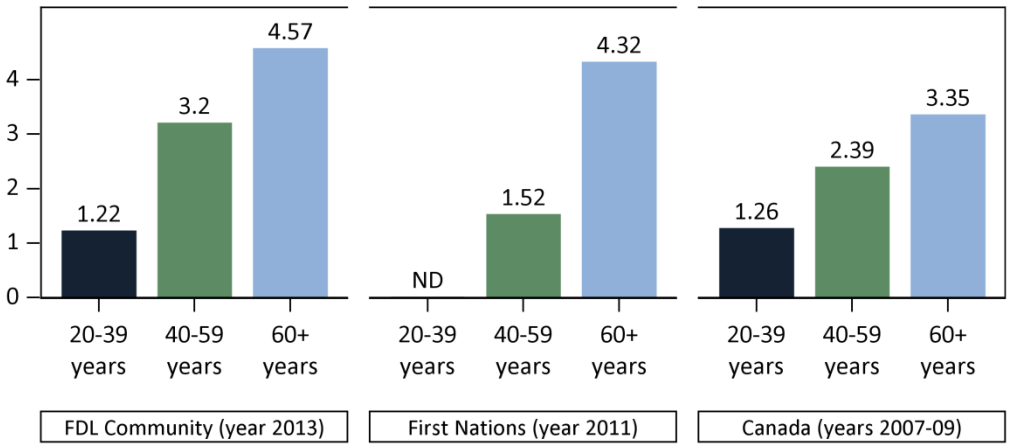
in nanograms of toxaphene per gram of lipid in blood



ND=Not detected in at least 50% of people based on the Canadian/First Nations detection limit, so a middle value cannot be calculated. Using the lower detection limit available only for the FDL Community, the median for the youngest and middle FDL age groups respectively are 0.42 and 0.76 nanograms per gram.

95 Percent Values for Toxaphene 50

in nanograms of toxaphene per gram of lipid in blood



ND=Not detected in at least 95% of people, so a 95 percent value cannot be calculated

Other Persistent, Bioaccumulative Chemicals

Mirex

We found mirex in 1% of participants. Mirex was used as an insecticide (mainly in the southeastern U.S.) and as a flame retardant in plastics, paint, paper, and electrical goods. It was banned in the U.S. in 1978. The biggest exposure source is fish from Lake Ontario and other waters impacted by old Mirex manufacturing sites. *Mirex has not been found in Lake Superior fish or fish from Minnesota's inland waters.*